DOCUMENT RESUME

ED 407 237 SE 059 984

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|---|---|
| TITLE | MSEN Long-Range Goals 1996-2000. University of North Carolina Mathematics and Science Education Network. |
| INSTITUTION | North Carolina Univ., Chapel Hill. Mathematics and Science Education Network. |
| PUB DATE | Apr 96 |
| NOTE | 17p. |
| PUB TYPE | Reports - Descriptive (141) |
| EDRS PRICE | MF01/PC01 Plus Postage. |
| DESCRIPTORS | Educational Objectives; Elementary Secondary Education; Higher Education; Inservice Teacher Education; *Institutional Advancement; *Institutional Mission; Institutional Role; *Mathematics Education; *Organizational Objectives; Partnerships in Education; Policy Formation; Professional Continuing Education; *Science Education; Teacher Centers; Teacher Workshops |
| IDENTIFIERS | University of North Carolina |

ABSTRACT

The University of North Carolina (UNC) Mathematics and Science Education Network (MSEN) applies the resources of UNC to strengthen mathematics and science education in K-16 schools throughout the state of North Carolina. MSEN has 10 centers located on university campuses statewide and six pre-college sites at these universities. University faculty direct center operations and provide workshops and courses for K-12 teachers. These professional development offerings bring teachers into contact with university faculty, scientists, and other professionals to expose them to the most current educational research. This publication of MSEN's long-range goals begins with vision and mission statements, followed by lists of beliefs and policies. Long-range goals are: (1) increase the number of underrepresented students who pursue mathematics- and/or science-based fields of study at the post-secondary level; (2) develop, implement, and evaluate programs that integrate technology into the teaching of K-12 mathematics and science; (3) conduct an ongoing and systematic program of assessment to identify those areas in North Carolina's mathematics and science education that need improvement; and (4) sponsor and conduct research and development in mathematics and science education. This booklet concludes with an Executive Summary. (PVD)

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# MSEN Long-Range Goals 1996-2000

## University of North Carolina Mathematics and Science Education Network

*Dedicated to Mathematics and Science Education Innovation in North Carolina*

# Long Range Goals, 1996 – 2000

## UNC Mathematics and Science Education Network

## Vision

MSEN applies the knowledge and resources of the University of North Carolina to strengthen mathematics and science education throughout the state. The Network assists students, teachers, and communities by networking, integrating research and best practice, professional development, enhancing student learning, curriculum development, and assessment and evaluation.

## Mission

To improve the quality of mathematics and science teaching and learning in the schools of North Carolina, the UNC Mathematics and Science Education Network provides statewide leadership in an effort to: (1) strengthen the quality and increase the size of the teaching base in mathematics and science education; and (2) increase the pool of students who graduate from North Carolina high schools prepared to pursue careers requiring mathematics and science.

# Beliefs

1. Given equal access to educational opportunities, all students can learn significant and relevant mathematics and science.

2. Teachers serve as a critical link in our efforts to reform mathematics and science education; they must therefore have access to cutting-edge professional development experiences.

3. Parents, administrators, and teachers can create a culture in which all students are expected to succeed in mathematics and science.

4. Mathematics instruction should enable students to develop and create mathematical power and knowledge for themselves.

5. Science instruction grounded in direct experience, fosters a student's understanding of science concepts and the process of scientific inquiry.

6. In order to be relevant and meaningful, mathematics and science curricula must relate to other curriculum areas and must serve a student's immediate and life-long needs.

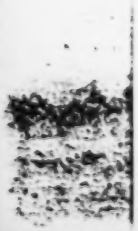
7. In order to be mathematically and scientifically literate workers, all students must have access to modern technological resources.

8. To implement an effective mathematics and science curriculum, teachers must create and facilitate a classroom which emphasizes direct experiences, analytical thinking skills, and problem-solving.

9. Strategies for assessing progress should emphasize a student's ability to think critically, solve problems, and apply the processes of scientific inquiry.

10. Pre-service education and professional development in mathematics and science must introduce teachers to current research in the field and must provide them with the most effective strategies available.

11. Systemic reform in mathematics and science education requires action at all levels.



# Policies

1. We will facilitate programs and information networks which improve the content knowledge and pedagogical skills of the state's mathematics and science teachers, K-12.

2. We will support North Carolina's schools and school systems in their efforts to increase the participation and achievement of minorities and females in mathematics and science.

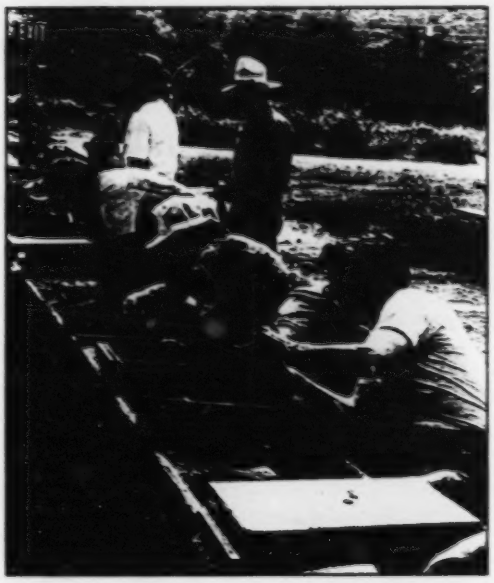
3. We will collaborate with North Carolina's schools and school systems and with the Public Schools of North Carolina to design short-term and long-term programs in mathematics and science education for all teachers and students.

4. We will collaborate with and support local, regional, and national initiatives which aim to improve fundamentally the teaching and learning of mathematics and science, K-12.

5. We will help keep education leaders from across the state up-to-date on current ideas of mathematics and science teaching and learning.

6. We will provide teachers with the opportunities to learn about validated curricula and state-of-the-art technology in mathematics and science education.

7. We will work with pre-service education programs as they strengthen and improve the preparation of teachers of mathematics and science.



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# Goals

## Goal 1

**Maximize our potential to develop large-scale and/or high-impact programs in mathematics and science education through collaborative efforts with all Mathematics and Science Education Centers, other statewide and regional systemic initiatives, and agencies for pre-service education.**

- *Improve and increase the quality and quantity of multi-center projects that serve teachers in their region and across the state.*
  Plan of Operation:
  - Enhance efforts at combined center initiatives by co-sponsoring workshops and writing grant proposals together.
  - Narrow our foci and identify key Network and Center projects, and carefully document the results.
  - Allow more time for the Center directors to meet so they can collaborate more effectively.
  - Work with the MSEN and Center Advisory Boards and similar groups in order to maximize MSEN and Center contributions to the improvement of mathematics and science teaching.

- *Actively pursue participation with other statewide and regional systemic initiatives.*
  Plan of Operation:
  - Collaborate with all stakeholders in mathematics, science, and technology education regionally, statewide, and nationally.
  - Make greater efforts to unite with other professional entities to obtain support, e.g. DPI, SERVE, SSI, etc.
  - Develop and implement MSEN's vision by collaborating with peers in the area: Colleges of Education, Colleges of Arts and Sciences, Colleges of Engineering, Community Colleges, schools, communities, business, and industry.
  - Identify centers across the nation similar to MSEN with which we can collaborate.

- *Work with appropriate agencies to improve the effectiveness of pre-service education in mathematics and science.*
  Plan of Operation:
  - Work with the universities' General Administration to define MSEN's and the Centers' role in this area.
  - Work with faculty members of Colleges of Arts and Sciences, and Colleges of Education to strengthen the effectiveness of pre-service mathematics and science education.
  - Assist and encourage colleges to conduct and implement pilot projects to improve pre-service education.
  - Whenever appropriate, work with pre-service students enrolled in mathematics and science methods classes.

## Goal 2

**Increase the number of underrepresented students who pursue mathematics- and/or science-based fields of study at the post-secondary level.**

- *Expand Centers' professional development offerings for those mathematics and science teachers involved in the Pre-College Program.*
  Plan of Operation:
  - Provide a consistent professional development program for Pre-College teachers.
  - Incorporate into Center activities nationally validated programs that support or encourage equity and diversity.

- *Develop a plan to recruit and encourage underrepresented students to pursue mathematics- and science-related careers.*
  Plan of Operation:
  - Provide support to Pre-College students during the transition period from middle school to high school to decrease attrition.
  - Study the impact of the Pre-College Program regarding students' choice of careers after they have graduated from high school.
  - Encourage underrepresented students to participate in competitions.

- *Publicize the Pre-College Program's achievements.*
  Plan of Operation:
  - Prepare dissemination strategies of programs and materials.

- *Explore possibilities of expanding sites or establishing satellite centers at currently established Pre-College Programs to include elementary students as well as more rural, economically disadvantaged and other underrepresented students.*
  Plan of Operation:
  - Create a pilot program for economically disadvantaged and underrepresented students that can serve as a model.
  - Support a state conference to look at new models or successful programs for underrepresented students.

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## Goal 3

**Develop, implement, and evaluate programs that integrate technology into the teaching of mathematics and science, K-12.**

- *Develop a plan for professional development programs which fulfills that part of the state technology plan which calls for the use of technology in the schools.*
  Plan of Operation:
  - Review statewide efforts to improve technology education.
  - Identify current successful Center programs that use technology to teach pre-service and in-service teachers.
  - Develop methodologies for using technology in the classroom.
  - Offer teachers professional development programs based on the methodologies we have developed.

- *Locate and utilize funding resources to support technology initiatives.*
  Plan of Operation:
  - Develop business collaborations to help schools acquire hardware and software.

## Goal 4

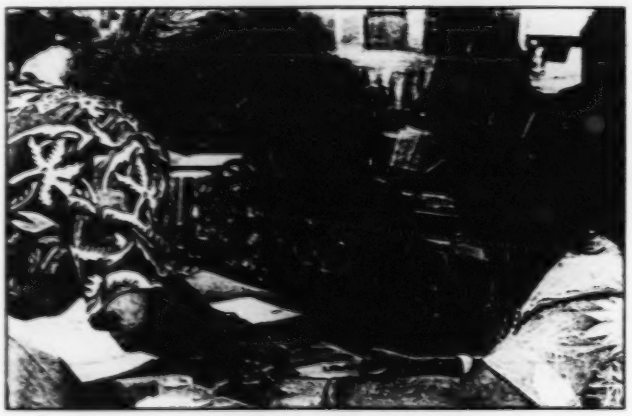
**Conduct an ongoing and systematic program of assessment to identify those areas in North Carolina's mathematics and science education which need improvement.**

- *Work with the universities to strengthen professional teacher certification or preparation programs in mathematics and science at three levels of certification: elementary, middle, and high school.*
  Plan of Operation:
  - Review and recommend an exemplary elementary mathematics and science program.

- *Develop a program evaluation process that will move beyond existing plans to include relevant program outcomes, such as increased student achievement and improved teacher practice.*
  Plan of Operation:
  - Document and identify the content background and teaching skills in mathematics and science of elementary, middle, and high school teachers before, during, and after programs.
  - Develop strategies to measure student achievement outcomes.
  - Link student outcomes and teacher practice.

- *Develop a method or assessment instrument to record and evaluate non-traditional workshop activities (e.g. Family Math/Science Nights, resources that can be checked out by faculty and students, etc.).*

- *Develop a needs assessment instrument that can be used and adapted by individual MSEN centers to assess regional needs in mathematics, science, and technology education.*
  Plan of Operation:
  - Include all stakeholders in the needs assessment process.



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## Goal 5

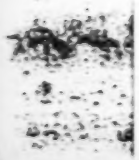
**Sponsor and conduct research and development in mathematics and science education.**

- *Support additional resources for a research component to MSEN programs.*
  Plan of Operation:
  - Seek funding for these resources.

- *Identify essential components in professional development programs that enhance student achievement and teacher practice.*
  Plan of Operation:
  - Increase research and evaluation of the programs we conduct in order to show their impact on the students.
  - MSEN will evaluate the effectiveness of the Pre-College Program by determining whether: (a) students have improved their performance in mathematics and science, and (b) these students major and graduate from college in science-, mathematics-, and engineering-related areas.
  - Assess the impact of MSEN's professional development programs by monitoring the students of project participants. For example, interview teachers and students to assess students' understanding and/or misconceptions.

- *Develop products (e.g. curriculum materials, software, audio-visual materials) for dissemination that are outcomes of our research and outreach.*
  Plan of Operation:
  - Publish technical reports and research findings on the Centers' activities and related efforts.
  - Seek funding for such publications.

- *Plan action research projects for teachers to promote teacher change.*
  Plan of Operation:
  - Build research plans into our professional development programs to understand better how to change teacher practice.



## Goal 6

**Develop strategies which will support mathematics and science teachers from across the state in their efforts to collaborate and communicate with MSEN and with all levels in the educational enterprise, business, industry, government, and policy-makers across the state.**

- *Communicate MSEN's resources with a home page on World Wide Webb.*
  Plan of Operation:
  - Link each Center to its university home page.
  - Link each Center to all other Centers' and the Network's home page.
  - Establish links to other professional teaching groups (e.g. NCSTA, NCCTM).
  - Update current information and resources regularly.
  - Publish press releases and other publications (where feasible) on the home page.

- *Communicate with all mathematics and science teachers across North Carolina through a periodic newsletter.*
  Plan of Operation:
  - Provide policy and statewide educational information.
  - Incorporate Center information and programming more extensively than in the past.
  - Offer professional development activities, free materials, conference information, and grants.
  - Make the newsletter highly responsive and usable to teachers.

- *Communicate with policy makers, legislators, university administrators, and the governor's office through a periodic bulletin of information.*
  Plan of Operation:
  - Provide information that is relevant to our continued usefulness in mathematics and science education in North Carolina.
  - Include teacher success stories.
  - Include articles on the Pre-College program, grants the centers and the Network office receive, and publications written by Network and Center staff.
  - Provide information on the success of our organization.

- *Create a monograph of articles written by the center directors, staff, and other contributors, publish this in book form, and distribute across the state and nation.*
  Plan of Operation:
  - Collect articles requested from center directors, staff, and other contributors and edit according to the style of the monograph.
  - Publish this monograph through UNC Press (if possible).
  - Offer the monograph as an available publication both in the newsletter and on the home page.

- *Whenever possible, have an MSEN representative attend public meetings as well as conferences, state-level meetings, local-level meetings, the legislature if applicable legislation comes before the General Assembly, in the schools, at teacher meetings, etc.*

- *Write and distribute press releases to media contacts on a regular basis in order to become a recognized name among media people.*

  Plan of Operation
  - Distribute press releases directly to media personnel (by name).
  - Make follow-up contacts when possible.
  - Center directors write press releases and distribute locally and to the Network office so they can be distributed to Network contacts.

# UNC Mathematics and Science Education Network
## Executive Summary

In fulfilling its mission, the University of North Carolina Mathematics and Science Education Network applies the resources of the university system to strengthen mathematics and science education in K-16 schools in North Carolina. Not only does MSEN offer programs for teachers, students, and school administrators, it also works to improve curricula and build partnerships between universities, schools, parents, and businesses.

MSEN, with 10 Centers located on university campuses statewide, with six Pre-College sites at these universities, takes a systems approach from a university base. University faculty direct the operations of the centers and provide workshops, seminars and courses for K-12 teachers; these professional development offerings bring them into contact and working relationships with other university faculty, scientists, mathematicians, business/industry executives, and graduate students, and expose them to the most current educational research. MSEN's academic programs are designed and presented by university faculty. Through these partnerships, MSEN works to "strengthen the quality of and increase the size of the teaching base in mathematics and science education in North Carolina as well as to increase the pool of students who graduate from North Carolina high schools prepared to pursue careers requiring mathematics and science."

MSEN was originally conceived by Chancellor Christopher Fordham of UNC-Chapel Hill and Dean Sherman Burson of Arts and Sciences and Chancellor E.K. Fretwell at UNC-Charlotte. The Network received a key endorsement by Governor James Hunt's Business Committee on Math/Science Education in January 1984. The Committee was formed by Governor Hunt to consider the relationship of science and mathematics education to economic development and included the CEO's of many of the state's leading businesses and the managers of its largest industrial facilities. As a result, the Committee's support of MSEN carried considerable weight in the legislature which voted to permanently fund MSEN in 1984.

- One of MSEN's key strengths lies in its two complementary components: professional development and the Pre-College Program.

These two components, (a) professional development, which serves teachers, and (b) the Pre-College Program, which serves underrepresented students, allow teachers to apply concepts learned in workshops and seminars directly in the classroom. On the one hand, the Pre-College Program provides a laboratory for the concepts taught in the professional development programs, and conversely the Pre-College Program is strengthened by these concepts.

- Since its conception, MSEN and its Centers have brought in millions of dollars in outside funding from such sources as the National Science Foundation, the U.S. Department of Education, the Carnegie Foundation, and the Z. Smith Reynolds Foundation.

In 1988, MSEN set out to develop a teacher leadership model, in which MSEN-trained teacher leaders would help reform schools statewide. In 1988-89 the Glaxo Foundation provided funding for a pilot teacher-leader project at all eight MSEN teachers education centers, and in 1990 this was followed by a three-year grant from

the U.S. Department of Education's Fund for the Improvement and Reform of Schools and Teaching (FIRST). The Glaxo and FIRST projects impacted education at several hundred elementary schools in all corners of North Carolina, proving the validity of the teacher-leader concept.

- A key to the success of MSEN's programs is the partnerships and cooperative relationships they help create with such organizations as the Public Schools of North Carolina, the North Carolina Mathematics and Science Coalition, and the North Carolina Science and Mathematics Alliance.

Through these working relationships, new curricula have been implemented and data analysis and statistics have been brought to the elementary curriculum; moreover, in response to the new state requirement that all students must pass Algebra I for high school graduation, mathematics teachers were given intensive workshops in 1991 at locations across the state.

- Many of the workshops offered to teachers at each of the Centers around the state are funded through foundation and private support.

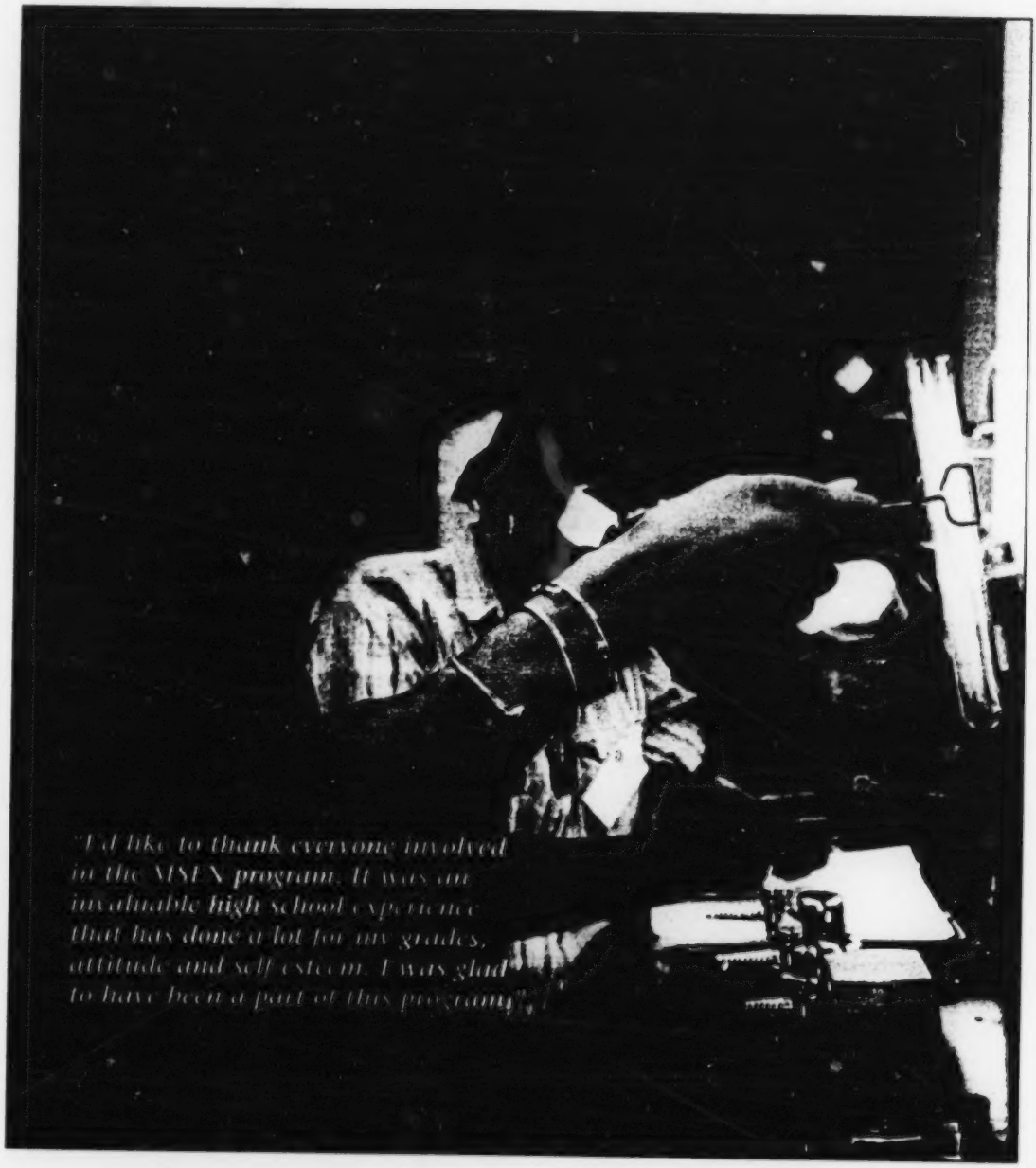
In 1994, NSF provided a new grant to support earth science education for middle and high school teachers, including both curriculum development and in-service education. Much of the money received by the Centers is only available to university-level faculty; thus the association between the university and the Centers becomes an important aspect of our structure, one which is not duplicated in any other organization across the state.

- In the last three years MSEN and its Centers have raised more than $5,000,000 in outside funding. As a result, state appropriations are about 30% of the total budget of the Network and its Centers.

MSEN and its Centers are state assisted rather than state supported. A major emphasis at each office is grant writing in order to provide more workshops and seminars for mathematics and science teachers and to bring in much needed funding. The majority of state funding pays operational costs for each Center and the Network office. At the same time, the external funding brought into the Network and its Centers provides a certain amount of operational funding to the host universities.

- The MSEN Pre-College Program had its start in 1985-86 with funding from the Carnegie Foundation and the National Action Council for Minorities in Engineering and has since expanded from four Pre-College sites to six (Elizabeth City State, Fayetteville State University, NC State Uuniversity, NC A&T State University/UNC-Greensboro, UNC-Charlotte, UNC-Chapel Hill). Permanent funding from the state legislature was approved in 1986,1988, and 1992.

The Pre-College program is designed to increase the number of historically under-


"I'd like to thank everyone involved in the MSEN program. It was an invaluable high school experience that has done a lot for my grades, attitude and self esteem. I was glad to have been a part of this program."

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represented students – minorities and females – who have sufficient interest and preparation to pursue mathematics and science fields at the university level and to move into careers in science, mathematics, technology, engineering, and teaching. The Pre-College Program is structured to provide students with in-school programs, Saturday academies, a summer scholars program, a parental-involvement component, and leadership and career awareness activities.

- Since its inception, approximately 97 percent of graduating Pre-College students go on to college. The Pre-College Program has graduated about 650 students from the program and continues to track these students after they leave high school.

The success rate of the Pre-College Program is shown in the scores on statewide tests. For example, Pre-College students scored four points above the statewide average on the Algebra I test and four points above the statewide average on the physical science test. The percentage of Pre-College students enrolled in Algebra I is consistently higher than the state average in grades eight and nine. These numbers demonstrate that, when given a rigorous academic program and the appropriate support, a traditionally low performing group of students in mathematics and science can work hard and achieve success. The program can be summed up by what one 1994 graduating Pre-College student had to say: "I'd like to thank everyone involved in the MSEN program. It was an invaluable high school experience that has done a lot for my grades, attitude and self-esteem. I was glad to have been part of this program."

- In the end, the success of the students is the true measure of any program. Between 1990 and 1994, North Carolina eighth grade students went from scoring 250 to 266 on the National Assessment of Educational Progress Scale (NAEP).

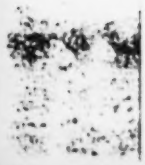
In 1990 we ranked 12 points below the national average and in 1994 we ranked even with the national average. In four years, North Carolina schools made significant changes in its ranking, and no other states can identify such improvements.

- During the 1994-95 school year, MSEN Centers conducted 274 professional development programs for a total of 122,555 contact hours for 5,130 teachers. Follow-up efforts by the Centers include visits to the teachers' classrooms to support them in their use of the content background and materials received in the professional development program.

While numbers do not show direct results of the programs, the comments and the program evaluations by the teachers clearly demonstrate the effectiveness of the programs, faculty, and materials. About 65% of the teachers who participated in the programs planned to use the material they learned regularly and 30% said they would sometimes. Ninety-five percent of the teachers rated the activities challenging or very challenging. One teacher wrote on his/her evaluation that the program was "Wonderful! This is by far the most informative workshop I've ever attended. I plan to use these activities in my classroom."

MSEN strives to meet the mathematics and science teacher needs in North Carolina. By partnering the university and K-12 communities, MSEN is exposing university faculty, teachers, and students to a broader learning environment that challenges those who participate. The external funding MSEN generates strengthens not only program offerings, but research opportunities for teachers and faculty. Our unique pairing of the K-16 communities is a step toward improving our statewide academic standing not only in the U.S. but globally as well.

*UNC Mathematics and Science Education Network*



## Mathematics and Science Education Centers

MSEN operates 10 Mathematics and Science Education Centers and six Pre-College sites across the state. (+ denotes Education Center with Pre-College Program site; * denotes Pre-College Program site only)

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